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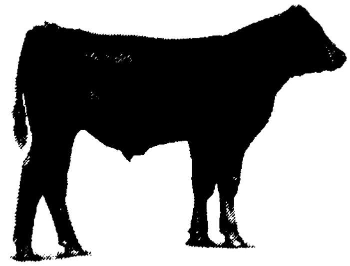

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IMPLANT PROGRAMS FOR FINISHING HEIFERS

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INTRODUCTION: STRATEGIC IMPLANTING

Use of implants in beef cattle growing and finishing systems should be thought of as hormonal growth promotion, not application of some "magic" treatment that improves performance. Implants differ in type of hormone, potency or action. Selection of appropriate implant/reimplant strategies must consider cattle sex and type, nutrition, management and marketing. Thus, strategic implantation programs should be designed. Strategic implant programs should match available resources (cattle, feed, labor and management) to specific production and marketing goals. In some cases, feeding to less than 50% choice while avoiding yield grade 4 carcasses is the preferred objective. In other cases, feeding to 90% choice and accepting some 4's is appropriate. Implant strategies might be dramatically different in these situations. With very large framed cattle, avoiding heavy carcass discounts may be a goal that dictates implant choice, whereas, feeders of small or medium framed cattle have more options.

While ideal implant programs for steers are relatively well defined, several factors make designing hormonal growth promotion programs for heifers more complicated. This paper will review pertinent research and describe what is known about strategic implanting of heifers. Unfortunately, not all questions have research-based answers at this time.

UNDERSTANDING THE BIOLOGY

Understanding the mechanism of implant action helps to explain the benefits, risks and proper strategies. Decades ago, observation of differences in growth rate and muscularity between the sexes led researchers to investigate whether hormonal treatment of growing cattle could improve productivity. This research led to development of androgenic (male) and estrogenic (female) implants.

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Classification of implant types is shown below, products that are currently approved for use in heifers in the U.S. and their chemical components are listed in table 1.

CLASSIFICATION OF IMPLANT TYPES

Estrogenic	Androgenic
Natural - estradiol	Natural - testosterone
Synthetic - zeranol	Synthetic - trenbolone

Both estrogens and androgens have direct effects on muscle cells inducing greater muscle protein deposition either through increased synthesis or decreased degradation of skeletal muscle protein. In addition, both classes of hormones have indirect effects on muscle. Androgens reduce plasma cortisol concentration (a classic difference between bulls and steers), reduce the quantity of cortisol carrier protein, and compete with cortisol for cellular binding sites. These actions impede the anti-anabolic actions of cortisol, resulting in greater muscle deposition. Estrogens increase circulating somatotropin, which increases protein deposition. Neither androgens nor estrogens have significant direct effects on fat cells, however, through altered nutrient partitioning, these hormones reduce fat deposition.

STRATEGIC IMPLANT PROGRAMS FOR HEIFERS

Theoretically, the most effective strategy would be hormone replacement, ie. implanting bulls (for beef) with estrogens, heifers with androgens, and steers with both. In practice, choosing the most effective strategy is more complicated than that. Cattle type, facilities, nutrition and management, risk management, marketing and previous implant status all must be considered when selecting the appropriate implant strategy. Since trenbolone, the active compound in trenbolone acetate (TBA)-containing implants, has both androgenic and anti-estrogenic properties, considerations become more complicated when TBA is included in the implant program. Although TBA is classified as an androgen, there is evidence that effects of testosterone and TBA-containing implants are not identical. TBA by itself is only marginally effective as a growth promotant in steers but is more effective in heifers. However, the combination of TBA and estrogen (TBA+E) increases growth, efficiency and muscle deposition of steers to a greater extent than either hormone alone. It is clear that TBA+E will produce maximal growth rates and muscle deposition in steers. Optimal programs for heifers are less clear.

Whenever implant programs for heifers are discussed, melengestrol acetate (MGA) must be considered. MGA is a synthetic, orally active progestin that is included in the diets of feedlot heifers, rather than implanted. MGA suppresses estrus, improves growth rate and feed conversion efficiency (4 to 8%) with minimal alteration of carcass composition. MGA works through two mechanisms. MGA induces a hyperestrogenic state and thus increases circulating somatropin, which in turn stimulates growth. Suppression of behavioral estrus also contributes to improved performance by reducing sexual behavior and maintaining consistent feed consumption but researchers now think that the effect of suppressed estrus on improved performance is less great than the effect of increased somatotropin estrogen.

Since progestins, by themselves, have little anabolic activity, stimulation of growth resulting from treatment with exogenous progestins is likely due to their interaction with endogenous hormones. Since MGA induces a hyperestrogenic state, inclusion of MGA in the feeding program is somewhat like implanting with estrogen. In the past few years, some cattle feeders have removed MGA from their heifer programs and utilize other means to suppress estrus. Use or nonuse of MGA must be considered when devising an implant strategy.

To develop a strategic implanting program for heifers, four questions must be evaluated:

1. Which implant program is most effective when MGA is included?
2. Which implant program is most effective when MGA is not included?
3. Under which circumstances should MGA be included?
4. How do programs for spayed heifers differ from programs for intact heifers?

This paper will attempt to describe what research has shown regarding those questions.

Question 1. Which implant program is most effective when MGA is included?

Heifers that are fed MGA should be implanted with an androgen (testosterone or TBA). Since no implants contain only testosterone, testosterone vs TBA comparisons cannot be made using commercially available products. The comparison that is made is testosterone+E (Synovex-H or Heifer-oid) versus TBA. Data in table 2 suggest that if only one implant is used, Finaplix will provide the greatest benefit. Conclusions based on a single study should be made cautiously, however. For example, the work of Hartman et al. (1989; table 3) suggests that reimplanting (with Synovex, Finaplix, or both) not only failed to improve performance but actually made it worse.

Nonetheless, data in Table 2 indicate that MGA + Finaplix-H will produce more weight gain than MGA + Synovex-H. This is an important observation because if these two products resulted in equal performance, Synovex would be used due to lower cost.

Based on data included in table 4, it is relatively clear that implanting with both Synovex-H and Finaplix-H results in maximal growth when MGA is fed. The improvement over use of either implant alone (17 lb of liveweight or 10.5 lb of carcass weight) is more than sufficient to pay for the added cost of the second implants.

Question 2. Which implant program is most effective when MGA is not included?

The work of Preston et al. (1987; table 5) represents the most complete characterization of the interaction between various levels of TBA and E in heifers not fed MGA. In this work, the most effective combination of TBA and E was 140 mg TBA/28 mg E, followed by 0/20 (with 200 mg testosterone), 200/20, 200/0 and 0/0. On day 70 of the 169 day experiment, cattle in the 0/20 treatment group were reimplanted, cattle that received treatments containing TBA were not. Prior to this reimplantation, the 200/20 treatment was superior to the 0/20 treatment.

In a recent summary of pertinent trials (Rains, personal communication), it was shown that TBA+E, or TBA+E+testosterone resulted in 17 lb more liveweight marketed than testosterone+E when MGA was not fed, and 16 lb more when MGA was fed. In other words, differences between these implant combinations were similar whether MGA was fed or not. With either implant treatment, MGA-fed heifers had approximately 40 lb greater liveweight than those not fed MGA.

However, without MGA, Synovex often produces greater performance than Finaplix, when an estrogenic implant does not accompany Finaplix. Thus, if only one implant is to be used, and MGA is not fed, a testosterone implant (Synovex-H or Heifer-oid) will produce the greatest benefit. This is not a particularly agressive program.

There is some question whether TBA alone will increase growth in heifers to the same extent that TBA+E does. Galbraith (1980) and Henricks et al. (1982) reported increases in heifer performance of greater than 20% in response to TBA alone. These workers used implants containing 300 mg TBA, whereas Finaplix-H contains 200 mg TBA. Moran et al. (1989) reported that TBA alone improved growth (for the effective life of the implant) more than TBA+E.

These primarily European studies may not be applicable to answer current feedlot questions because of dietary differences. The diets of Galbraith, 1980; Henricks et al., 1982; and Moran et al., 1989, were relatively low in energy and supported only moderate growth rates. In these studies, energy consumption above that required for maintenance was lower than in typical feedlot situations. Because TBA increases muscle deposition by reducing protein degradation (a process that contributes greatly to maintenance requirements), while estrogens increase protein synthesis, cattle implanted with TBA alone should have lower maintenance requirements than those implanted with E, or TBA+E. This difference in maintenance requirements may be insignificant in cattle consuming high energy diets ad libitum, but of significant magnitude in cattle consuming moderate energy diets. Thus, the fact that 300 mg TBA results in excellent growth promotion in heifers growing at moderate rates should not be considered proof that 200 mg TBA will produce growth equal to TBA+E in high energy fed heifers. It is conceivable that exogenous E administration to heifers is not required, but it is the view of the author that either exogenous (implanted) or endogenous (due to feeding MGA) estrogen will enhance TBA or testosterone-induced growth promotion.

Question 3. Under which circumstances should MGA be included?

Upjohn has sponsored studies comparing MGA feeding with TBA implants to implantation with testosterone+E (Synovex-H or Heifer-oid). These studies were conducted at Colorado State University (table 6) and at a commercial feedyard in Kansas (table 7). Averaged across both trials, MGA with TBA resulted in 8.0 or 5.9% greater ADG depending on feeding period length. Including several other studies, the advantage in sale weight to MGA+TBA cattle is approximately 16 lb. This is important since MGA+TBA will cost more (approximately $4/hd) than implanting with Synovex-H or Heifer-oid.

If one considers testosterone equal to trenbolone, these studies would indicate that feeding MGA is superior to implanting with estradiol. However, testosterone and trenbolone should not be compared directly. In vitro experiments have shown that trenbolone has 50-100 times the androgenic potency that testosterone has, so 140 or 200 mg of trenbolone would be considered a much greater dose of androgen than 200 mg of testosterone. In addition, although both are considered androgens, trenbolone binds to estrogen receptors, exerting anti-estrogenic effects and binds to progesterone receptors. In addition, although increased circulating estrogen is a beneficial result of MGA feeding, it should not be considered to be identical to implanting with estrogen. Indeed, there are examples of estrogen implantation improving performance of MGA-fed heifers.

It has become clear over the past several years that feedlot heifers can be kept from cycling without feeding MGA. When heifers, especially calves, are placed rapidly on high energy diets, few, if any will cycle during a feeding period of typical length. Increased dietary energy and more calves on feed have led to a recent decline in the number of heifers fed MGA. However, as described previously, preventing estrus may be the smaller of two MGA-induced benefits. Growth-promoting benefits may suggest that MGA should be fed to heifers even if they are not likely to cycle. Based on the summary of Rains, described in the answer to question 2, it appears that MGA should be included in all heifer diets. This will come as a surprise to some feedyard operators but it should not be forgotten that MGA does more than keep heifers out of heat.

To date, the majority of heifer studies have utilized yearling heifers. Considerations may be different when feeding weaned calves.

Question 4. How do programs for spayed heifers differ from programs for intact heifers?

Spaying of heifers, to suppress estrus and related behavioral problems, is not generally economically beneficial for heifers entering the feedlot directly because of the expense, initial weight loss and increased mortality. In addition, removal of ovaries diminishes estrogen-induced somatotropin release. Spaying heifers that will be placed on grass for the summer is more common and can be cost effective. As an alternative to spaying, ovaries can be removed, and a portion of ovarian tissue grafted to another part of the body. Theoretically, this autograft prevents estrus but allows growth promoting effects of ovarian tissue. Results from autograft experiments are highly variable and clear consensus of opinion cannot be drawn. In actuality, since complete removal of all ovarian tissue is difficult with any spaying technique, and since ovarian tissue has slight regenerative capabilities, spaying can result in a situation similar to spaying plus grafting if heifers are grazed and/or fed for a sufficient number of days. Because of this, some feeders are including MGA in diets of spayed heifers, anticipating that remaining ovarian tissue is sufficient to respond to MGA. With or without autograft, limited data suggest that implanting spayed heifers is essential. Implant strategies for spayed heifers may be similar to those for intact heifers.

DO ALL CATTLE TYPES RESPOND SIMILARLY?

It is the view of the author that two variables determine the magnitude of response to implants. First is the capability of the cattle to deposit muscle (and non-muscle protein), this is primarily under genetic control but opportunity for compensatory gain may also be involved. Second is the availability of substrate for anabolism (nutrient content of diet and quantity consumed).

Researchers at Cornell University have reported that effects of TBA+E on Holstein steers are significant, but less than the effects on beef breed steers. Ongoing research at the University of Minnesota is comparing the response of heifers with differing genetic capability to deposit muscle to two implant programs. Studies designed to evaluate the effects of TBA+E on various beef breed types have not been reported. As a general rule, the implants and implant combinations will be ranked in the same order regardless of cattle type and plane of nutrition, however, differences between products become greater as performance increases. It may be that the most potent growth enhancing implant/reimplant program will be the most cost effective in high performance cattle, while a less costly program is most cost effective in cattle with less potential for growth

TROUBLE SHOOTING IMPLANT PROGRAMS FOR HEIFERS

There are two potential problems that may be associated with implant programs for heifers; reduction in quality grade, and behavioral/masculinity problems.

Reduction in quality grade. In virtually all studies reported, use of TBA reduced either average quality grade, percentage of choice cattle or both, in comparison to nonimplanted or E implanted cattle. This has been observed in both steers and heifers, calves and yearlings and in both exotic and British breed steers, although the observed reductions are often more severe in studies involving exotic steers. While average quality grade is seldom reduced more than 1/3 of a grade, grade is usually reduced from low choice to high select, an economically important reduction. In some studies, as few as 40% of the TBA treated cattle have graded choice, while 70 to 80% of the cattle in other treatment groups graded choice. Typically, the percentage of choice cattle in a pen declined 5-15 percentage units with TBA use. This has often occurred with little difference in fat thickness. This has become a source of great consternation to cattle feeders and some have ceased use of TBA due to the reduction in quality grade they have observed.

There are two possible explanations for this effect. It may be that TBA exerts a marbling-specific effect, reducing marbling preferentially to other fat depots. This seems a bit far-fetched, although there are numerous accounts of reduced quality grade with equal external fat thickness. In the authors view, it is more likely that reduced quality grades are a function of the experimental design used by most experimenters. Since use of TBA increases muscle deposition by as much as 50 lb per carcass, treated cattle slaughtered after the same number of days on feed would not have the same carcass composition as controls, even if external fat thickness was the same. Under these circumstances, it makes little sense to expect treated cattle to have the same quality grade as controls, especially when it is considered that intramuscular fat is a late maturing fat depot. Since TBA increases muscle deposition and slightly depresses fat deposition, cattle treated with TBA will be substantially heavier at any given quality grade than controls. In addition to faster rates of gain, TBA treated cattle must be fed longer than controls to attain equal quality grades. TBA would actually have to **increase** the ability of cattle to marble for cattle to grade equally after the same number of days on feed.

If it is accepted that TBA treated cattle will grade choice eventually, the question becomes: How much heavier do cattle have to be to grade choice when treated with TBA+E? Fox et al., (1990), and Anderson et al., (1991) have reported results of work designed to address this issue. Extra weight required to produce marbling scores equal to nonimplanted steers ranged from 46 lb, in Holstein steers, or 88 lb, in Angus and Angus x Simmental steers to as high as 174 lb in 3/4 Simmental steers. This type of research has not been reported in heifers but it is likely that added weight required to attain choice marbling in heifers implanted with TBA is similar to that of steers with similar growth potential. The question is far from resolved but a possible reduction in quality grade in response to TBA+E should be considered when selecting an implant program. A corollary problem would be excessive carcass size in large framed cattle treated with TBA+E and fed until they grade choice.

Inclusion of TBA in an implant program makes timing of reimplant, and timing of marketing, in relation to day of implant, more critical than in programs involving E-containing implants alone. This is partly due to the fact that Finaplix implants have a shorter lifespan than other products. It also seems that the benefits of TBA can be lost during the latter part of a feeding period if TBA is not reimplanted, whereas benefits of traditional implants are thought to be maintained, even without reimplant. Because of this, timely reimplantation of TBA is essential. Feeders who cannot project slaughter dates accurately, or cannot pen market, may choose not to utilize TBA. If timing of group marketing can be accurately predicted, and/or if the discount for select grade carcasses is slight, inclusion of TBA at 90-105 days prior to slaughter should be considered.

Masculinity and increased sexual behavior. Most cattle feeders report increased masculinity of cattle implanted with TBA+E, especially when cattle are reimplanted with the combination at least once. Foutz et al. (1990) reported an increase in visual "bullock score" of carcasses from steers implanted with Revalor or Synovex + Finaplix. Strohbehn et al. (1990) reported increased visual "masculinity score" of steers implanted with TBA+E, compared to nonimplanted or implanted with E alone. Others have reported increases in proportional head weight in response to TBA+E. Wood et al. (1986) observed a proportional increase in the weight of neck and shoulder muscles in steers implanted with TBA+E. Indeed, the TBA+E-induced increase in muscle deposition is unfortunately greater in the lower valued cuts of the chuck than in any other part of the carcass.

Increased masculinity or "stagginess" can be as prevalent in heifers as in steers. This is most common when the TBA+E+testosterone combination is used, and both implants are reimplanted. Since Finaplix implants do not run out at the same time as Synovex or Heifer-oid implants, incorporation of combined implants into an implant/reimplant program can result in some hormonal gaps, where one hormone runs out but another has not, or overlap, where two sources of the same hormone are present. These imbalances, particularly overlap, seem to be the cause when the most significant occurrences of stagginess in heifers have been reported.

Research studies have not reported increased aggressive or sexual behavior but cattle feeders suggest that this can be a problem, especially in cattle that are implanted with TBA more than once. A possible explanation for the discrepancy between feedlot experience and research studies is in the size of the pens utilized. Riding is typically reduced in small research pens, regardless of cattle type or treatment, while it may occur in large feedlot pens. If TBA increases riding, potential exists for both reduced performance and increased rate of injury, especially if pen surface is slippery. Destructive behavior, often a problem with bulls, does not seem to be increased noticeably with TBA use.

A common, low-risk strategy would be to feed MGA, implant with Ralgro until 95 days from slaughter, then both Finaplix-H and Synovex-H as the terminal implant choice. Use of zeranol early in the feeding period allows avoidance of potential hormone overlap or withdrawal problems. This strategy may include an unnecessary component that could be deleted without sacrificing performance, but research reported thus far has not been designed to elucidate the most efficient strategy.

Implanting technique seems responsible for some of the reported behavioral problems. Cattle that have crushed implants, and thus rapid payout of hormone into the bloodstream, seem to be the "riders". The "ridees", those cattle being ridden are those that have abscessed or walled-off implants and thus, less hormone than the average of the pen. For more complete discussion of potential problems resulting from incorrect implant delivery or placement, see Rains and Nash (1990).

This paper deals with implants for feedlot heifers, however brief discussion of breeding cattle is warranted. Estradiol, zeranol and trenbolone inhibit pituitary LH secretion, and thus long term exposure to these hormones can affect puberty and fertility of bulls and heifers. Bulls intended for breeding should not be implanted. Silcox et al. (1986) and Henricks et al. (1988) reported reduced scrotal circumference, testis weight, sperm production and response (LH production) to a GnRH challenge in bulls implanted with TBA, compared to nonimplanted controls. Heifers intended for breeding should not be implanted with testosterone or TBA. Moran et al. (1989) reported that TBA, but not E, impeded normal mammary development in heifers. Both TBA and zeranol significantly delayed first estrus and reduced the number of heifers that ovulated (Moran et al., 1990), compared to nonimplanted, or E-implanted heifers. Some data indicate that zeranol and estradiol implants should be avoided as well, while other studies suggest that these implants do not affect fertility of females.

IMPLANTING CULL COWS

Garnsworthy et al. (1986; table 9) implanted culled dairy cows with 300 mg TBA and slaughtered them after 60 or 100 days on feed. Implants increased ADG by 21 and 42% in the two groups with F/G reduced by 22 and 25%. The increased weight gain due to the implant was primarily due to increased muscle deposition in these cows that were in average condition at the start of the experiment. Implants are not approved for use in culled cows in the U.S. but administration of TBA to cull cows would likely increase weight gains. It is not known whether E is required for maximum response cull cow to TBA, although this may be less likely in cows than in other types of cattle. Response of cull cows to estrogenic implants alone is variable but seems to be slight at best. Differences in the response of cows in thin or fat condition to implant administration is also unknown.

Due to the potential for favorable weight gain and feed conversion of thin cull cows, as well as the seasonal increase in cull cow price that typically occurs from October through March, feeding of cull cows for 45 to 90 days is often profitable. Implantation of cull cows merits serious consideration for cow/calf producers who have facilities to feed cows after weaning or can sort cows that will be culled prior to weaning. Feedlot operators may also consider purchasing, implanting and feeding culled cows, although this proposition is not without risk.

SUMMARY

Heifers can be implanted with estradiol, testosterone, trenbolone or zeranol, or with combinations of these hormones. In addition, feeding MGA results in changes in circulating hormone concentration. Spaying and autograft are additional possibilities. Thus, strategic use of hormonal growth promotants can be quite complicated and searching published reasearch for the answers to all possible questions can be frustrating. Nonetheless, some conclusions can be drawn. MGA should be fed for growth promotion, even if cycling heifers are not a problem. In general, feeding MGA, and implanting with TBA, estradiol and testosterone will produce maximum performance. This is the most costly possible strategy and it is likely that this strategy includes some unnecessary component, however, research to streamline this program has not been conducted. If a single implant is used, with or without MGA, TBA produces greater gains than testosterone+E, but also costs more. Inclusion of TBA in an implant program typically results in a slight reduction in quality grade. It is the opinion of the author that quality grade depression can be almost entirely avoided through timely marketing, but the reader should consider that others may not share this opinion. These conclusions are based almost entirely on experiments conducted with yearling heifers.

TABLE 1. TRADE NAME, CHEMICAL COMPONENT AND QUANTITY OF ANABOLIC GROWTH STIMULANTS APPROVED FOR FEEDLOT HEIFER USE IN THE U.S.

Trade name	Chemical component	Quantity
Compudose	Estradiol-17B	24 mg
Finaplix-H	Trenbolone acetate	200 mg
Ralgro	Zeranol	36 mg
Synovex-H	Testosterone prop.	200 mg
	Estradiol benzoate	20 mg
Heifer-oid	Testosterone prop.	200 mg
	Estradiol benzoate	20 mg
MGA	Melengestrol acetate	.25-.5mg/d

TABLE 2. EFFECTS OF MGA AND IMPLANTS ON FINISHING HEIFER PERFORMANCE, KANSAS

MGA Implant	No None	Yes None	Yes Finaplix	Yes Synovex
No. of heifers	191	192	191	187
Starting wt, lb	690	695	682	686
Final wt, lb	1011	1035	1030	1026
ADG, lb	2.57	2.73	2.78	2.72
ADFI, lb DM	18.3	18.9	17.9	18.9
F/G	7.11	6.93	6.42	6.95
Choice+Prime, %	71.7	72.4	69.0	70.7
YG 4+5, %	3.2	6.8	3.7	8.1
Dark cutters, %	0	0	0	.5
Value of gain, $	221.13	245.16	250.38	244.80
Feed cost, $	119.78	123.83	117.21	123.80
Return to feed, $	105.63	115.43	127.56	115.10
MGA cost, $	----	2.25	2.25	2.25
Implant cost, $	----	----	5.70	1.73
Net return, $	105.63	113.18	119.61	111.12
Benefit, $	----	7.55	13.97	5.49

Clay et al., Upjohn Tech. Rep. No. 76
Crossbred heifers fed 125 days.
Implanted on d 1, reimplanted on d 59.

TABLE 3. EFFECT OF E, OR TBA+E, ON FINISHING HEIFER PERFORMANCE, KANSAS

Implant Reimplant	Synovex None	Synovex Synovex	Synovex Finaplix	Synovex Syn+Fin
No. of heifers	33	31	31	31
Reimplant wt, lb	857	857	857	857
Final wt, lb	1103	1095	1093	1100
ADG, lb	3.13	3.05	3.03	3.12
Fat thickness, in	.46	.45	.47	.51
Percent choice	97	94	87	77

Hartman et al. (1989).
Crossbred yearling heifers (724 lb) fed 127 days, reimplanted on d 49.
MGA included.

TABLE 4. EFFECTS OF IMPLANTS ON FINISHING HEIFER PERFORMANCE, NEBRASKA

	Synovex	Syn+Fin
Start wt, lb	819	819
End wt, lb	1157	1175
Carcass wt, lb	729	740
ADG, lb	3.79	3.97
ADFI, lb	24.7	23.7
F/G	6.68	5.99
Choice + prime, %	81.6	78.5

BEEF, June, 1991
Crossbred heifers fed 90 days, MGA included.
All weights and performance adjusted to 63% dress.

TABLE 5. EFFECT OF VARIOUS DOSES OF TBA AND ESTRADIOL ON PERFORMANCE AND CARCASS CHARACTERISTICS OF HEIFERS[a]

TBA E	0 0	200[b] 0	200[c] 0	140 28	200 20	0 20[d]
ADG, kg	0.95	0.98	0.96	1.09	1.03	1.08
DMI, kg	6.9	6.9	6.7	7.5	7.1	7.3
F/G	7.3	7.0	7.0	6.9	6.9	6.8
REA, cm	70.3	73.5	74.2	75.5	74.2	71.6
Fat th, cm	1.6	1.3	1.4	1.2	1.3	1.4

[a]Crossbred heifers (270 kg), fed 169 days.
[b]Cholesterol based implant.
[c]Lactose based implant.
[d]Also contained 200 mg testosterone, reimplanted on d 70.
Preston et al., 1987.

TABLE 6. EFFECTS OF MGA AND IMPLANTS ON FINISHING HEIFER PERFORMANCE, COLORADO

	Fed 111 days		Fed 139 days	
MGA Implant	No Heifer-oid	Yes Finaplix	No Heifer-oid	Yes Finaplix
No. of heifers	72	71	69	72
Starting wt, lb	649	650	650	652
Final wt, lb	1051	1092	1135	1178
ADG, lb	3.62	3.99	3.45	3.78
ADFI, lb DM	19.0	20.0	19.2	20.2
F/G	5.25	5.01	5.45	5.31
Choice, %	69.6	67.6	55.2	73.9
Feed, $/cwt gain	30.12	29.33	31.62	31.27
Return, $	719.72	743.93	731.62	777.90

Stanton et al., 1991.
Implanted on d 1, Synovex reimplanted on d 56, Finaplix not reimplanted.
Return over feed and implant cost.

TABLE 7. EFFECTS OF MGA AND IMPLANTS ON FINISHING HEIFER PERFORMANCE, KANSAS

	Fed 129 days		Fed 160 days	
MGA Implant	No Synovex	Yes Finaplix	No Synovex	Yes Finaplix
No. of heifers	119	117	119	119
Starting wt, lb	631	626	639	638
Final wt, lb	1039	1058	1115	1122
ADG, lb	3.14	3.33	2.96	3.00
ADFI, lb DM	19.0	18.7	19.4	18.9
F/G	6.06	5.63	6.55	6.31
Choice, %	48.3	64.7	58.5	49.6
Feed, $/cwt gain	44.01	41.45	47.57	46.45
Return, $	648.05	663.89	662.11	669.19

Crossbred heifers.
Implanted on d 1, Synovex reimplanted on d 56, Finaplix not reimplanted.
Return over feed and implant cost.

TABLE 8. EFFECTS OF IMPLANTS ON FINISHING HEIFER PERFORMANCE, OKLAHOMA

Treatment	Control	TBA	TBA+E	Testo+E	Zeranol
Start wt, lb	614	621	618	619	618
Final wt, lb	902	914	946	917	910
Carcass wt, lb	556	562	571	564	551
ADG, lb	2.40	2.45	2.74	2.49	2.44
ADFI, lb	17.0	17.1	17.8	17.5	17.6
F/G	7.15	6.99	6.56	7.01	7.22
Quality grade	12.5	11.8	11.7	12.3	11.9

Gill et al., 1987
Crossbred yearling heifers fed 105 days, no MGA.

TABLE 9. THE EFFECTS OF TBA ON PERFORMANCE AND CARCASS CHARACTERISTICS OF CULLED DAIRY COWS FED FOR 60 OR 100 DAYS[a]

	Fed 60 days		Fed 100 days	
	Control	Implanted	Control	Implanted
ADG, kg	1.12	1.35	0.92	1.31
ADFI, kg	11.6	11.9	12.9	14.7
F/G	10.1	7.9	12.7	9.5
Carcass wt, kg	271.2	280.8	284.2	300.8
Lean wt, kg	172.6	183.6	177.6	190.4
Total fat wt, kg	48.5	46.1	56.4	60.4

[a]Implanted with 300 mg TBA, average condition score of all cows = 2.18 (1 = thin, 4 = fat) at beginning of experiment.
Garnsworthy et al., 1986.